

1 18. The combination of claim 16 wherein said
2 burner has heat radiating surfaces configured to
3 radiate heat predominately in directions toward said
4 legs.

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7 19. The combination of claim 16 wherein said
8 legs are in series communication.

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11 20. The combination of claim 16 wherein the
12 burner has a gas permeable metal fiber zone γ_1 , and
13 non-gas permeable zone γ_2 , where γ_1 faces said legs
14 and γ_2 faces away from said legs, γ_1 subtending an
15 angle that is less than 180°.

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1 21. Endothermic catalytic reaction apparatus
2 comprising:

3 a) a helical tubular flow through reaction
4 chamber disposed within a combustion chamber, and
5 catalyst contained within said reaction chamber for the
6 conversion of hydrocarbon to industrial gases by
7 reaction with steam; said helical tubular reaction
8 chamber having an upper portion, and there being a
9 convection chamber extending about said upper portion
10 to enhance the transfer of heat from combustion
11 products in the reaction chamber and an exit section to
12 convey reaction products to the exit means, and

13 b) a radiant burner vertically disposed
14 within said combustion chamber and having a gas
15 permeable zone that promotes the flameless combustion
16 of fuel and oxidant supplied to said burner in order to
17 heat the metal fiber surface of the burner to
18 incandescence for radiating heat energy to the reaction
19 chamber; said radiant burner configured to radiate
20 uniformly in radial directions.

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23 22. The combination of claim 21 wherein said
24 tubular reaction chamber comprises a tube having outer
25 diameters ranging from about $\frac{3}{4}$ inch to about 4 inches,
26 along the tube length.

1 23. The combination of claim 21 wherein said
2 tubular reaction chamber defines a coil having an outer
3 coil diameter ranging from 6 to 36 inches.

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6 24. The combination of claim 21 wherein said
7 helical tubular reaction chamber is for creation of
8 mass velocities ranging from
9 400 lb/ft²/h to 1500 lb/ft²/h.

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12 25. The combination of claim 21 wherein said
13 catalyst in the helical tubular reaction chamber has
14 average catalyst particle diameters ranging from $\frac{1}{4}$ to 1
15 inch for producing gas pressure drops ranging from 1
16 psi to 8 psi during flow through the reaction chamber.

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19 26. The combination of claim 21 wherein said
20 helical tubular reaction chamber has gas exit end
21 temperature ranging from 1150°F to 1400°F, when heated
22 by said radiant burner, in operation.

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